

Mineral Resources

OF

WYOMING



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Mineral Resources of Wyoming

There are few states in the Union that possess mineral resources as vast and varied as those of Wyoming. The late Prof. Knight of the State University identified 156 of the varieties of mineral noted in Dana's System of Mineralogy as occurring in Wyoming, and this list is constantly being added to as the different formations are opened up and understood.

Gold, silver, copper and lead all have been known for years in almost every mountain range in the state, and the work of the past few years has demonstrated beyond a doubt that these ores exist in commercial quantities.

Until now the crying need of these resources has been railroad transportation, but that need has been supplied by the building of the new roads into the central part of the state, and an unprecedented activity is now apparent in these camps. The quality and quantity of these ores have been assured for years and it is now possible to get them to market on a commercial scale.

Up-to-date investors are now searching the camps of Wyoming for the mines that meet their requirements, and means and brains are now making mines out of these long-neglected prospects, and even at this early date the results are flattering.

There is not another Rocky Mountain state with greater possibilities than Wyoming, or that offers better opportunities for mineral investments; certainly none with so much public domain subject to location as mineral land, and, besides the precious metals, the wealth of coal, oil and natural gas will some day make Wyoming as great a producing and manufacturing state as Pennsylvania is to-day.

Gold Mining—Gold mines were first worked at South Pass, Fremont County, in 1867, since which date the industry has amounted to something each year. The annual production has fluctuated from \$25,000 to \$125,000, the total being estimated at \$4,000,000 produced.

The placer mines that were rich enough to be worked with limited means were worked out long ago. Large tracts of placer gold ground, that can only be worked with great expenditure of

money and the most modern and economical devices, remain. These are now owned by large companies who are arranging to work some of them.

The Douglas Creek placers in Albany County are being worked and a number of new plants will be installed as soon as the season is open.

The gold usually occurs in quartz veins, which are found in all the mountain districts, the most promising of which are as follows: South Pass, Atlantic, Copper Mountain and Black Rock in Fremont County; Seminoe, Gold Hill and the Sierra Madre Mountains in Carbon County; Jelm, Medicine Bow and Centennial in Albany County; Black Hills in Crook County; Shoshone and Absaroka Mountains in Big Horn County, and the Laramie Hills.

Silver and Lead—These metals are found in small quantities in all the prominent ranges. Galena is the usual ore carrying silver, but at the Esterbrook mine, in northern Albany County, a vein of cerusite or silicious lead carbonate has been found. The silver values vary from ten to six hundred ounces per ton, and the lead from twenty to sixty per cent. in commercial ores. Shipments have been made from camps in Crook, Big Horn, Albany and Laramie Counties.

Copper—During the past few years copper in commercial quantities has been found in nearly all of the thirteen counties of the state, and development work is being actively pushed. The principal ore is usually a chalcopyrite or yellow sulphide of copper, associated with the rarer forms. These forms are usually covered by a capping of oxidized iron, in which the oxidized forms of copper, usually the blue and green carbonates, are found. The Grand Encampment Copper District, in southern Wyoming, is the leading producer, and active camps are being established in the Laramie Hills, Shoshone Mountains, Owl Mountains, Copper Mountain, the Wind River Range and the Big Horn Mountains.

Coal—Coal mining has been the leading mineral industry in the state, and will, in all probability, continue in the front rank for a time, though copper is fast gaining upon it. It had its origin with the advent of the transcontinental railroad, and has increased with the development of the state, until to-day it employs over 10,000 workmen and has a production of 5,805,272 tons of coal per annum.

Coal-bearing formations underlie a larger proportion of Wyoming than of any other of the Rocky Mountain states. Most of the productive area in Wyoming is included within the Plains region. More than half of the coal produced in Wyoming is lignitic in character, a large proportion of the lignite output coming from the fields which extend from North Dakota through South-

eastern Montana to the northeastern part of Wyoming. Most of the bituminous fields are in the more mountainous regions, and their areas, like those of the other Rocky Mountain fields, are small compared with those of the lignite beds in the northeastern part of the State. Among the more important producing areas are the Carbon and Hanna fields, in Carbon County, which include the operations at Hanna and Carbon; the Rock Springs field, in Sweetwater County; the Ham's Fork field, in Uinta County, and the Almy field, also in Uinta County, the last two counties producing nearly 75 per cent. of the State's entire output. The principal lignite production is at Sheridan, in Sheridan County. Most of the lignite is black in color, and, having many of the characteristics of bituminous coal, is frequently classed as such by the producers. The other fields which have not yet been reached by railroads are the Henry's Fork field, in the southern part of Sweetwater County; the Wind River field, in Fremont County; the Big Horn Basin, in Big Horn County, and the Teton field in the northern part of Uinta County. Another field penetrated by the Union Pacific system is the Rawlins field, extending from the southern part of Fremont County through Northeastern Sweetwater into Carbon County. The operations here are not of great importance. The Sublette field, in the western part of Uinta County, crossed by the Oregon Short Line, is also of little importance.

The kinds of coal vary from a pure lignite to a high grade long-flamed bituminous variety. The best grades of coal are low in sulphur and ash, and are excellent fuels for locomotives, general steam making, domestic purposes and gas production.

A semi-anthracite was discovered in Johnson County in 1887. Coking coal has been discovered in two or three localities, and seventy-four Beehive coke ovens are operated at Cambria, Weston County, having an output of over 20,000 tons per annum. All coke so far manufactured in this state has been made at Cambria, and Wyoming stands eleventh in the coke-producing states.

A TABLE OF GENERAL INFORMATION RELATING TO WYOMING COAL

GENERAL INFORMATION			ASSAYS				KIND OF COAL	
CITY	FIELD	COUNTY	Water	Vol. Matter	Fixed Carbon	Ash		Fuel
Rock Springs	Rock Springs	Sweetwater	5.38	36.42	55.60	2.60	92.02	Bituminous
Hopkins	Rock Springs	Sweetwater	5.55	36.95	55.70	1.80	92.65	Bituminous
Black Butte	Rock Springs	Sweetwater	14.23	31.00	49.85	4.92	80.85	Lignite
Mine No. 1	Rock Springs	Sweetwater	4.11	40.10	53.41	2.38	93.51	Bituminous
Spring Valley	Spring Valley	Uinta	5.46	39.42	52.32	2.80	91.74	Bituminous
Cumberland	Cumberland	Uinta	4.38	39.25	52.60	3.77	91.85	Bituminous
Almy	Evanston	Uinta	7.37	34.88	48.75	9.00	83.66	Semi-bituminous
Red Canon	Evanston	Uinta	7.42	36.08	48.50	8.00	84.58	Semi-bituminous
Rawlins	Rawlins	Carbon	6.55	32.85	54.00	6.60	86.85	Bituminous
	Kindt	Carbon	4.87	35.68	55.15	4.30	90.83	Bituminous
Hanna	Hanna	Carbon	8.09	44.52	43.84	3.55	88.36	Semi-bituminous
Carbon	Carbon	Carbon	7.42	35.43	48.30	8.85	83.73	Semi-bituminous
Glenrock	Glenrock	Converse	13.82	33.03	47.75	5.40	80.78	Lignite
Cambria	Cambria	Weston	5.72	40.13	43.65	10.50	83.78	Bituminous coking
Buffalo	Buffalo	Johnson	13.55	25.05	45.30	6.10	80.35	Lignite
Higby	Sheridan	Sheridan	13.05	37.55	44.70	4.70	82.25	Lignite
Monarch	Sheridan	Sheridan	15.40	36.38	42.32	5.51	82.70	Lignite
	Brier Hill	Crook	5.25	41.70	44.98	8.07	86.68	Bituminous
	Dutton	Albany	11.85	34.65	47.30	6.20	81.85	Semi-bituminous
Kemmerer	Twin Creek	Uinta	3.53	43.58	51.36	1.53	94.94	Bituminous
	Gros Ventre	Uinta	8.50	41.15	46.95	3.40	88.10	Bituminous
	Seminole	Carbon	11.01	33.27	48.48	6.24	81.75	Semi-bituminous
Thermopolis		Big Horn	9.75	33.25	50.30	7.00	83.55	Lignite
Lander	Lander	Fremont	11.40	36.60	47.60	4.40	84.20	Lignite
Lander	Owl Creek	Fremont	5.68	32.88	46.58	14.86	79.46	Lignite
	Casper	Natrona	11.30	32.10	53.55	3.20	85.65	Lignite
Big Muddy P. O.	Glenrock	Natrona	11.50	38.40	43.70	6.40	82.10	Lignite

The coal fields are so universal that commercial coal is known to exist in every county, and in all but one coal mines are worked. The area of workable coal land is over 20,000 square miles. The coal veins are numerous. It is not an uncommon thing to find six or eight workable veins in a single field. In thickness the seams vary from a few inches to 75 feet. The coal mines operated at present have working veins varying from four to forty feet. The coal lands are owned, to a large extent, by the government, but are subject to location. Already three great railroads have penetrated these fields, but the industry has only started, and by the close of another quarter of a century Wyoming will be producing not less than 10,000,000 tons of coal per annum.

Wyoming stands twelfth in the list of coal-producing states, and while the amount produced in other states has remained stationary in the past two years, the amount produced in Wyoming has increased twenty per cent.

Statement of Coal Output for Year ending September 30, 1906.
DISTRICT NO. 1.

OWNER	ADDRESS	MINE	TONS
Diamond Coal & Coke Co.	Diamondville	No. 1	168,694
Diamond Coal & Coke Co.	Oakley	No. 2	175,444
Diamondville Coal & Coke Co.	Glencoe	No. 4	230,908
Kemmerer Coal Co.	Frontier	No. 1	283,134
Kemmerer Coal Co.	Frontier	No. 3	93,639
Central Coal & Coke Co.	Sweetwater.....	No. 1	130,399
Central Coal & Coke Co.	Rock Springs	No. 2	181,500
Union Pacific Coal Co.....	Hanna	No. 1	336,025
Union Pacific Coal Co.....	Hanna	No. 2	70,668
Union Pacific Coal Co.....	Hanna ..	No. 3	30,530
Union Pacific Coal Co.....	Cumberland	No. 1	535,474
Union Pacific Coal Co.....	Cumberland	No. 2	416,677
Union Pacific Coal Co.....	Cumberland	No. 3	63,939
Union Pacific Coal Co.....	Rock Springs	No. 1	419,940
Union Pacific Coal Co.....	Rock Springs	No. 7	346,215
Union Pacific Coal Co.....	Rock Springs	No. 8	339,224
Union Pacific Coal Co.....	Rock Springs	No. 9	331,158
Union Pacific Coal Co.....	Rock Springs	No. 10	353,389
TOTAL.....			4,506,957

DISTRICT NO. 2.

OWNER	ADDRESS	MINE	TONS
Sheridan Coal Co.	Sheridan	Nos. 1, 2 & 4	563,280
Cambria Fuel Co.	Cambria	Nos. 1, 2 & 3	409,935
Carney Coal Co.	Carneyville	No. 1	147,128
Cole Creek Coal Co.	Big Muddy	No. 1	15,718
Stilwell Coal Co.	Aladdin	No. 1	13,870
Wyoming Coal Mining Co.	Monarch	No. 1	76,268
Glenrock Coal Co.	Glenrock	Nos. 1 & 2	42,116
Mined at Thermopolis, Inez, Douglas, Cas- per, Sheridan, Lander and other places not reported to Inspector, estimated.....			30,000
TOTAL.....			1,298,315
TOTAL PRODUCTION, 1906			5,805,272

(From reports of Coal Mine Inspectors, 1906.)

Natural Gas—Accompanying the oil fields are numerous natural gas horizons. The gas pressure in the oil wells near Lander is very great and gas escapes are found at or near most of the oil springs. At Brenning Basin, near Douglas, in Converse County, a flow of gas has been struck in several wells, at a depth of 500 feet, and the gas has been piped and used for fuel and light in the vicinity, a pressure of 300 pounds per square inch having been noted. In the eastern part of Fremont County there are two natural gas escapes that are wonders. Some prospectors have dug shallow shafts and curbed them up with logs; the shafts are partially filled with water and the gas escapes with such violence as to cause the water in them to boil as though in a cauldron. There are numerous anticlinals in the state that are not associated with the oil districts, where large flows of gas may be looked for.

Bituminous Shale—In the Green River Valley and at Rock Springs there are great bands of rich bituminous shale, that equals the shales of Scotland, where an army of men are employed and the production is sold for millions of dollars per annum. The shales are burned in a retort, and the products saved are gas, oil, tar and ammonium sulphate. The richest of these shales assay 45 per cent. volatile matter.

Volcanic Ash—In several localities in Wyoming volcanic ash has been found. In Albany County, near Laramie, there is a bed four feet in depth. It is almost white and is so fine that the greater portion of it will pass through a 100-mesh sieve. Samples

of equal purity have been examined from Carbon and Sweetwater Counties. This material is used for scouring purposes. It is the base of sapolio, and is also used in geyserite soap.

Graphite—Veins of graphite are known at French Creek, Plumbago Cañon and Halleck Cañon, in Albany County, and in the Indian Grove Mountains in Carbon County. The veins are large and easily accessible. Analyses of samples from the various localities show the carbon contents to vary from 40 to 60 per cent. So far as known, the ore is of the amorphous variety and would make good fire-proof paint, stove polish or graphite crucibles.

Asphaltum—Along the north side of the Rattlesnake Mountains there are several deposits of asphaltum that occur below the oil springs. There is also another bed on the Shoshone Reservation, east of Fort Washakie. This has been formed about an oil spring and contains several thousand tons. The quality is excellent, quite free from foreign matter, and it would make a splendid paving material.

Manganese Ores—Ores that fall under this class have been found in Albany, Crook, Sweetwater, Big Horn, Uinta and Fremont Counties. The development is only slight, since the discoveries have been too far from railroads to warrant shipments. The ores are of good grade and are found in good sized veins. Samples from different localities vary from 40 to 55 per cent. manganese.

Epsom Salts—Epsom salts can be found in small quantities throughout the arid region, but in Wyoming it is found in large beds. Near Rock Creek there is a depression containing about ninety acres that is covered with this salt. The exact depth is not known. In this immediate vicinity there are several other beds, the total area of the Epsom Salt Lakes being given at 160 acres. The salt is as pure as the commercial product that sells in our drug stores for ten cents per ounce. These deposits are near the railroad, and, if properly handled, should enable a company to control the Epsom salt trade of America.

Building Stone—Building stones of innumerable varieties are common throughout the state. The sandstone quarries at Rawlins, Carbon County, have a large output, which is shipped to Colorado, Utah and Nebraska. The capitol and federal buildings at Cheyenne, and the State penitentiary are built of this stone. In Laramie County the Iron Mountain quarries furnish a beautiful white sandstone which is much in favor and has been used for the Stock Growers Bank building, several business blocks and the new Roman Catholic Cathedral at Cheyenne. Granite, limestone,

quartzites, serpentine marble and marble onyx are included in the varieties.

Gypsum—This mineral is very common and is found in all varieties. Beds varying from 20 to 100 feet in thickness are exposed along the mountain ranges. The mineral is very pure, and can be utilized for purposes where gypsum is required.

There is an opportunity for small gypsum plaster mills in nearly every part of the state, and with a cheap local production, the uses of this plaster would rapidly multiply, as it is of a very superior quality and suitable for exterior and interior uses.

Plaster of Paris—The Rocky Mountain Plaster Company is operating a plaster mill at Red Buttes. There is room and material in sight to supply a thousand mills; in fact, Wyoming could furnish the world with plaster of paris for a thousand years, and then not consider the beds exhausted.

Natural Plaster—In a few localities deposits of what has been called a natural plaster have been found. The mineral occurs in superficial deposits, varying from two to six feet in depth. It is pulverulent and has a light gray color. When a portion of the water has been driven off, it sets and forms a very hard cement.

Clays—Pressed and common brick are manufactured in the state, but at present there are no other clay industries. The clay beds are in abundance and are found in every county in the state. Common brick clay, fire clay, tile and terra cotta clay and potters' clay are found in thick beds in the sedimentary rocks, and not in superficial deposits, as they are usually seen in the northern and eastern states.

Bentonite, or "soap clay," is found in many parts of the state, and shipments are made from the beds at Rock Creek, Albany County, and Newcastle, Weston County, a number of cars being shipped every year from each place. This clay is used as an adulterant, as a filler in paper making and for medical purposes, being worked up and sold under the name of "Antiphlogistine."

By analysis this clay contains silica, alumina, iron, magnesia, sulphur and water, samples having shown over 89 per cent. of silica and alumina, 1 per cent. of iron, 3 per cent. of magnesia, 1½ per cent. lime and sulphur and 6 per cent. water. Some of these deposits have no iron, magnesia or sulphur. One of them has 3 per cent. iron and 3 per cent. magnesia.

Nearly every small town has brick yards in the immediate vicinity, as the clays are universal, and some remarkably fine commercial brick are made. The clay also makes very fine tiling for floors, fireplaces and all kinds of pottery and piping.

Tin—Black oxide of tin has been known in veins and as

stream tin in the Wyoming portion of the Black Hills for many years. Tons of stream tin have been mined and sold. The veins are slightly developed. There are good veins of tin of average richness, and before many years the tin mines of Dakota and Wyoming will be worked. Wyoming gained a medal at the World's Fair for her exhibit of stream tin.

Salt—Near Cambria, Weston County, a plant has been built to manufacture salt from Salt Springs, the water of which contains 22 per cent. salt, and other springs equally fine are noted in Johnson and Uinta Counties. In the latter place salt is produced for local consumption.

Quartz—The Laramie Mountains abound in large veins of pure quartz. When ground, it is valuable for glass making.

Glass Sand—There are numerous places in the state where glass sand is found. The beds near Laramie have been worked and proven.

Mica—Muscovite mica, the mica of commerce, is very plentiful in Wyoming, but there are only a few localities where it has been found in "book" of sufficient size to warrant mining. In Whalen Cañon, some eight or ten miles from Hartville, and at Grand Encampment, there are numerous large veins of feldspar containing first-class mica. The former has been worked to some extent and a small shipment made. Sheets squaring six inches have been taken out near the surface. It is first quality in every respect.

Feldspar—Orthoclase feldspar occurs in large veins in Whalen Cañon. It is free from detrimental minerals and is suitable for all purposes where orthoclase could be used.

Sulphur—Extensive deposits of native sulphur are known in Uinta County. The crude brimstone assays from 40 to 70 per cent. of sulphur. There are also very extensive deposits above Cody, on the Shoshone River, and on Sunlight Creek, north of Cody. Recently deposits have been opened in the vicinity of Thermopolis, in northern Fremont County, and still others are reported in the Owl Creek Mountains, recently opened for entry.

Bismuth—Bismuth ore of rare purity has been mined at Jelm Mountain, and shipped to the east for reduction. The ore is a mixture of carbonates and metallic bismuth, and assays from 50 to 65 per cent.

Sulphate of Aluminum—This mineral, which is usually called native alum, occurs in extensive deposits in Sweetwater and Big Horn Counties. It is the principal salt used in the manufacture of

commercial alums, and for this purpose it should be used in connection with the natural soda.

Fibrous Talc—A very large vein of fibrous talc exists in the Laramie Hills west of Wheatland, and there are veins of similar material of varying size and qualities in the Casper Mountains, Wind River Ranges and many of the smaller ranges throughout the state. This material is used for many of the rougher purposes of fireproof materials, and, with the improvement in transportation conditions, these Wyoming deposits will be worked.

Asbestos—On Casper Mountain and on Smith Creek, in Natrona County, are found deposits of a very fine quality of asbestos, and it is now being opened up and preparations made to put this valuable mineral on the market. This is the variety known as "Chrysotile," and is of a grade similar to that of the Canadian asbestos, which supplies the general trade at present, but will have a rival in the Wyoming product. The fiber is of good color, shows a length up to four inches and works up very soft and is easily spun. The full extent of the deposits is not yet known, but from surface indications is stated to be considerable. The varieties of asbestos known as crysolite, amphibole, fibrous talc and other impure forms also occur in various parts of the state, and some of them promise to be used in the future.

Decomposed Granite—Some nine years ago the Union Pacific Railroad Company commenced loading decomposed granite from a point near Sherman and hauling it out as ballast. It was found to be far superior to any other stone for this purpose, but it was also, to some extent, sold for road building in cities, a use to which it is well adapted.

Natural Pigments—Soft iron ores have been used for red paint for years. For many years paint mills were operated at Rawlins. The Brooklyn bridge was originally painted with this paint. More recently the ore has been shipped to other states to be ground. The soft hematite ores are in large bodies and make a first-class paint. Ochres of various shades are known, but the beds have not been worked. Graphite and the low grade asbestos that would make an excellent fire-proof paint are found in large bodies.

Semi-Precious Stones—The semi-precious stones are in abundance. Quartz crystals, agates, jaspers, moss-agates, petrified wood, garnets and beryls are the important ones. The moss-agates are the best found in the world. Thus far no precious stones have been reported.

Natural Soda—Extensive deposits of natural soda are known

in Carbon, Natrona and Albany Counties. Numerous springs contain considerable soda, and at Green River a well yields a saturated solution of sodium carbonate, which is shipped by the car load. The deposits vary in size from a few to one hundred acres, and the soda ranges from a few inches to sixteen feet, and possibly more. These deposits are chiefly sodium sulphate, but there are carbonates and bi-carbonates in some localities. Along the Sweetwater River there are deposits that contain 60 per cent. carbonate of soda. The sulphate, when dried and calcined, has been sold in the east for glass making, and was used in the Laramie glass factory. With proper machinery, these great beds of soda can be utilized and would bring in a large revenue.

The most valuable natural soda discovered in Wyoming is what is known as sodium carbonate, or the sal soda of commerce, and can be derived in inexhaustible quantities from wells, averaging a depth of two hundred feet, at Green River, the county seat of Sweetwater County, and on the line of the Union Pacific railroad. Samples of water taken from numerous wells at Green River yield an analysis of 20 per cent. of sal soda crystals.

Mineral Springs—Wyoming is prominent for her mineral springs. If we take into our estimate the Yellowstone Park, this alone surpasses the rest of the world in the number and magnificence of its waters. The mineral springs include hot, cold, sulphur, iron and the alkaline earths, and genuine mud springs. Notable ones, but by no means the most important, are at Death Lake, where they number more than four hundred.

A group of some fifty famous hot springs in the Platte Valley at Saratoga, in Carbon County, have a temperature of 130° F., have been extensively improved and have been used for twenty years to the great benefit of the invalid visitor. These springs are reached by the new Saratoga and Encampment R. R. from Walcott, on the Union Pacific R. R.

At Thermopolis, in the Big Horn Basin, the hot springs have an analysis nearly identical with the waters at the Hot Springs, Arkansas. These are protected by state law, and are under the control of the Board of Charities and Reform. The Burlington Route is completed to Worland and is rapidly extending towards Thermopolis at the present time.

The DeMaris Hot Springs at Cody, Big Horn County, are noted for their curative powers and are popular with the hunting parties and tourist parties to the Yellowstone Park via the Cody Gateway of the Burlington Route.

A famous hot spring is located two miles west of Fort Washakie, on the Shoshone Reservation. This spring is 320 feet long by 250 feet broad, with an average temperature of 149° F. The minerals held in solution are medicinal. It is held in great repute

by both whites and Indians as curative of rheumatism and neuralgia.

Another equally large, of sulphur, having a temperature of 97° F., exists near Lander, Fremont County, and is much sought by people outside of the state suffering with stomach, kidney, liver and bowel disorders. The completion of the Chicago and Northwestern R. R. into Lander has made these springs very convenient of access and their popularity is constantly growing.

In Beaver Cañon, north of Sheep Mountain, in Carbon County, a sulphur spring, with a temperature of 90° F., is found, and near by are cold springs which contain soda in solution, sulphur, iron, sulphuretted hydrogen and carbonic acid; still another in the Platte Cañon, at the east end of Seminoe Mountains in Carbon County, has a temperature of 98° F.

A spring with a temperature of 108° F. is located ten miles below old Fort Laramie; another at the head of West Horse Creek, whose temperature is 104° F.

There are many other springs scattered throughout the state, whose analysis suggests that they possess valuable medicinal qualities, but, owing to the limited number of people, lack of transportation and consequently small demand for mineral water, it has been impossible to develop many of them.

Limestone—The unprecedented demand for a pure limestone, to be used in the beet sugar factories in Colorado, has developed a trade at Laramie, Albany County, and Hartville, Laramie County, and some thousands of tons are shipped annually from these quarries. The limestone is very pure, containing 98 per cent. calcium carbonate, with very little silica, or injurious materials. This same stone exists in many other parts of the state, and factories may be assured of a constant supply in almost any locality where the beets can be grown.

Iron—Second to those of no state in the Union are the deposits of iron ore. Prospecting along this line has not been carried on to any extent, and only iron districts reasonably near the railroad have received any attention. The greatest deposits are red hematite, quite free from sulphur and phosphorus, and low in silica. The only districts where development or mining has been carried on are Hartville, Rawlins and Seminoe. In these camps are large deposits of soft ore, which makes an excellent pigment. The hard ores are found beneath the surface in bodies varying from ten to one hundred feet in thickness. Rawlins and Hartville or Guernsey have furnished thousands of tons of ore to be used by the Salt Lake and Denver smelters as a flux for lead and copper smelting, and two railroads have been built to the Hartville mines. Besides the hematite, there are great deposits of magnetite in the Laramie Mountains, and beds of clay ironstone in the cretaceous

rocks in several localities. Hematite ore has been found in Crook, Uinta, Johnson, Fremont, Big Horn, Albany and Sheridan Counties. The ores examined are of exceptional purity.

Iron Mines at Guernsey—The Hartville iron range in Laramie County, now known throughout the country as containing the finest and most extensive deposits of Bessemer steel ores in the world, has become the scene of vast operations. Two railroads, the Burlington and the Colorado and Wyoming, have been built into these fields. The mines now being worked are owned by the Wyoming Railway and Iron Company and held under lease by the Colorado Fuel and Iron Company. This company has a capital of \$25,000,000, and is rapidly enlarging its plant at Pueblo, Colo., making it one of the largest in the country. The mines are located at Sunrise, in the center of the iron belt, where a town has been built, and the work is progressing on an extensive scale.

The ore is mined in great open cuts, where the ore is blasted down from the sides and loaded into the cars by steam shovels, three of which are in active use daily, the cars being run into the cuts on side tracks from the main railroad and the ore shipped direct from the cuts with as little handling as possible. In this manner over 600,000 gross tons of ore have been mined, which, at a mine value of \$1.50 per ton, gives \$900,000 worth of crude iron ore. A three-compartment shaft, 350 feet deep, has been sunk, and three levels run to develop the underlying beds of iron ore hitherto neglected. This department will greatly increase the output of the mines and be a permanent part of the work.

The known area of the iron belt, which begins at Guernsey on the south, and runs to the head of Whalen Cañon, in a northeasterly direction, ten miles, with an average width of three miles, covers thirty square miles. The greatness of the deposit is shown by the fact that, although the Colorado Fuel and Iron Company has a lease of seventy-two patented claims, the present enormous output is obtained by working only two mines.

The ores are exceptionally pure and of the highest grade known, showing from 65 to 68 per cent. metallic iron, from 2½ to 5 per cent. silica, and are practically free from sulphur and phosphorus.

Rawlins Hematite—Two miles north of Rawlins, Carbon County, there is a large deposit of red hematite ore, occurring in a metamorphosed sandstone capped with limestone. The ore is remarkably pure, and in this vicinity there are several other locations which contain similar deposits.

Seminole Iron Deposits—One of the largest deposits of iron in Wyoming occurs in the Seminole Mountains, at the foot of Bradley's Peak, Carbon County. Bradley's Peak has been called a

mountain of iron ore, containing not less than 1,500,000 tons, and when development is begun here this locality will furnish an important part of the iron ore to be smelted in Wyoming, as it is estimated this ore can be mined and loaded in the cars for fifteen cents per ton.

GOLD DISTRICTS.

The South Pass Gold District, Fremont County.

This district is situated in the south central part of Fremont County, Wyoming, near the southern end of the Wind River range of mountains.

The extension of the new line of the Burlington road to be built up the Big Horn River from Frannie to Lander, and that of the Chicago and Northwestern now built from Casper to Lander, has brought this district within thirty-five miles of a railroad, and it is more than possible that branches will be run to the mines and greatly facilitate the operation of properties in this section.

Gold was discovered in this region in 1842, and from that time until 1869 efforts were made to work the rich placers known to exist there, when the great rush to South Pass occurred in the latter year, and the placers rich enough to pay when worked on a limited crude scale were promptly worked out and the miners sought other opportunities in the then new fields of Colorado and Montana.

Geology—The district may be said to consist of an island of metamorphic schists of the Algonkian period lying upon the granites of the Archean and with several intrusions of granite and dyke rocks in the schists at different localities. The granites of this section of the Wind River Range are usually the common red feldsitic granite, and here show an occasional gray granite island or band, usually of limited extent.

The schists show for a distance of about thirty miles long, from ten to twelve wide, the longer axis bearing northeasterly and southwesterly, in the same general direction as the strike of the schists, and with a general dip to the north, varying from 45 degrees to the perpendicular. Around these schists are the granites on the northwest and the succeeding sedimentary formations on the northeast and the tertiary formations on the southerly sides.

Nearly all the rocks of this region, but especially the above mentioned schists, show strong evidence of alteration and change, in many instances giving an appearance entirely foreign to the character of rock, but an examination with an ordinary field lens is often sufficient to determine the true character at once. This altering material is usually silica, and where the rocks are weathered as on an exposed outcrop, a hard quartzose character is noted,

and these are frequently called "dykes," but are simply altered schists and frequently carry gold values. Dykes occur in these schists, especially at the old Miner's Delight mine at Peabody Hill, where diorite and diabase dykes are noted; at the Mary Ellen Hill, near Atlantic; at the Carissa at South Pass, and along the northwesterly edge of the schist in the vicinity of the Little Joe, and at Gold Creek.

At the Miner's Delight dykes of porphyritic material are noted, and these extend to the "Rustler belt," north of Atlantic City, where the Mormon Crevice and Poirée estate properties have produced very rich ore.

The Carissa Mine at South Pass—This property, located in 1867, has been a phenomenal producer for many years, and development work is being carried on at the present time. The development consists of some 2,300 feet of drifting, etc., with a shaft 384 feet deep; following the dip to the vein, equipped with hoist and necessary appliances for handling the ore. The Carissa ore occurs in quartz lenses, lying in the schist, having the same dip and strike as the schist, and these lenses occur at irregular intervals.

Associated with the quartz lenses are bodies of mineralized schist, carrying pay values in gold, and lying between or near the lenses have been found schist ores of very high grade, but with the usual intervals of lower grade material in the same ore.

Until recently the development of these ores has been carried on on the high grade lenses only and the low grade ores practically ignored, owing to lack of facilities for treating them profitably, but during the past year a cross-cut has been run west from the lower or 400 level and the occurrence condition of these low grade ores determined. This cross-cut is 180 feet long and cut through a series of quartz lenses and schist leads, which were found to vary in value from a trace to \$50 per ton gold, but the free condition remained unchanged as in the other parts of the mine. Tests on this work showed an average mill value of \$6 per ton the whole length of 180 feet.

This is the most important work accomplished in the district for many years, as it demonstrates the existence of great bodies of low grade ore capable of treatment on a large scale and indicates the course to be pursued in the other mines of the district.

In the upper portion of the Carissa workings the usual oxidized ores were found, and these were very rich, as shown by the early history of the mine. As development proceeded the oxidized ores passed out and the sulphide forms came in, being mostly arsenical pyrites, but experience in milling these ores has shown the free gold character of the ore still pertains, and on the lower level from 60 per cent. to 90 per cent. of the gold values may be saved

on the plates and ore is frequently met with that shows free gold associated with the pyrites, both in the quartz and adjacent schists. The ore is being treated in a ten-stamp mill, with amalgamating plates and concentrating tables.

The Dexter Works at Atlantic—Atlantic City is the working headquarters of the Dexter Mining and Development Company of Rochester, N. Y. They have recently added to their original large holdings and are now operating the Tabor Grand, the Bryan, the Dexter Tunnel and Garfield, besides a number of smaller works.

This company holds placer ground on Rock Creek, consisting of 1,600 acres of patented placer ground, and controls the whole bed of Rock Creek to its junction with the Sweetwater River, about 3,000 acres of placer claims held by location in the usual manner. The Dexter Company has made extensive tests in the bed of this creek by hydraulic elevators and other mechanical means for handling the gravel, and will put in dredges as the result of these experiments. The water for this work is secured from Christina Lake and Rock Creek by a system of about twenty-five miles of ditches, flumes, etc. An interesting feature of these experiments is the high assays obtained from the black sand after the placer gold has been taken out, the remaining sand assaying from \$400 to \$800 per ton.

A new mill has been erected by the Dexter Company at a point on Rock Creek just below Atlantic to treat both their own and custom ores, extensive experiments having been made during the past year to determine the best method of treatment. This mill, which started in the spring of this year, is of 150-ton capacity, using twenty 1,050-pound stamps, with amalgamating plates and having complete cyanide department for saving values other than free gold.

The Miner's Delight, which was one of the famous mines of the west many years ago, is being opened up again after lying idle for years, and a complete plant of machinery is being installed to push deep work and put the mine again in the producer class.

The vein is a fissure from four to six feet wide, associated with the coarse crystalline porphyry noted above and contained very rich gold values, but was not developed over 250 feet in depth, as far as can now be ascertained.

Lewiston—At this camp, which was opened up in 1879, when the famous Burr mine was discovered, development has been slow for the past few years, but this season prospecting is again active, and a number of lenses of quartz have been found on Strawberry Gulch, which show the characteristic free gold condition of the Burr and other famous properties.

Production—The amount of gold produced from twenty-

eight properties in this district since its discovery is \$3,728,000. The gold taken from the great placers in the early days of the district, before anyone thought of statistics, can only be estimated and is placed at from \$2,000,000 to \$3,000,000. In this locality at the present time there are fifteen properties working, employing one hundred men.

There are fifty meritorious properties in the South Pass District that would pay handsomely on the development expenditure, and it is certain that this district will be heard from as a gold producer in the next few years.

Other Gold Camps.

The other gold producing districts in the state are scattered.

At Centennial, Gold Hill and Jelm Mountain, in Albany County, there are a number of properties working for gold alone.

Returns of gold working properties are received from the Sunlight mines, in Big Horn County; from Kirwin, on the head of Wood River, and the South Fork of the Shoshone River, in the same county.

Lode mining has been active in eastern Crook County, near Welcome, where the formations are fine grained schists, granites, etc., with some intrusions of trachite and allied rocks, overlaid near the rim of the uplift with limestone and succeeding sedimentary rocks.

Copper Mountain is the low range lying between Shoshoni and Thermopolis on the eastern side of the Big Horn River in Fremont County, and is being actively opened up as a gold and copper producer. Free gold is found in many of the properties, notably at the Williams-Luman Mine at Depass, at the eastern end of the district; the Hale Mine near Birdseye, Gilt Edge, Boyesen and others; a mill is being built at Hale's Mine and the tunnel at the Williams-Luman Mine will open up the ore at a greater depth than has yet been reached in the district. The formation is generally of granite with ledges of schist carrying the ore, and with veins and bodies of quartz heavily mineralized. Much of the ore is high grade.

Willow Creek is a new district being opened up west of Thermopolis that has shown up some fine ores but the details have not yet been given out. Both gold and copper are found in these ores.

During the past year a number of gold finds have been made in the granite hills that lie north of the Sweetwater River, east of Rongis, in Fremont County, and some high grade free gold ores returned. The formation is granite with huge ledges of mineralized schist with some quartz associated with the minerals contained. This is an entirely new district and is easy of access from central Wyoming points.

SOME OF THE PLACERS.

Douglas Creek, in Albany County, is one of the principal streams of the Medicine Bow Mountains, and has been noted for the placer gold found in it since the first history of mining in that section. Gold was first found here in Moore's Gulch, one of the tributaries of Douglas Creek, in 1868, and for many years every gulch in this district was worked by primitive methods with profit. Platinum is found in the placer sands here and recently remarkably high values have been found in the "black sands" of these creeks through experiments conducted under the United States Geological Survey.

Recently these placers have all been attracting the attention of mining men and a complete mechanical plant has been installed on the holdings of the Douglas Consolidated Placer Mining Co., to work these gravels by mechanical means under the immediate charge of experienced hydraulic engineers, and the results of this plant are being watched very closely by the whole district.

Other placers on Douglas Creek that have shown high values are the Home placers; the Albany placers, which are to be opened and worked by the American Gold Placer Mining Co.; the Spring Creek and Lake Creek placers and a dozen smaller properties which have production records and were only worked on a small and primitive scale.

In the southern part of Carbon County, placers are worked on Snake River, and in Crook County the placers of the old Nigger Hill section are worked at intervals.

Recently a number of placer finds have been made in the sands of Wind River near Shoshoni, in Fremont County, and some very high values have been obtained.

A number of placer works are scattered along the waters of the streams in the Wind River and Owl Mountains in Fremont and Big Horn Counties, Gros Ventre in Uinta County, and in the Big Horn Mountains west of Sheridan some properties have been worked for gold in the cement deposits on Bald Mountain.

Small placers are well known in Carbon, Albany, Big Horn and Fremont Counties, and thousands of dollars have been taken out in the past.

COPPER DISTRICTS.

Grand Encampment District.

The district popularly known as the "Grand Encampment" country lies in the southern part of Carbon County and the southwestern corner of Albany County, south of the main line of the Union Pacific railroad.

Mining has been carried on in this region from the earliest known period of the state's settlement, but the first permanent work was in 1872 in the Kurtz-Chatterton property on Copper Creek, west of where Encampment now stands. It was not until 1897-8 that the district became prominent by reason of some rich gold ores found in Purgatory Gulch, a small tributary of the South Fork of the Grand Encampment River, and the town of Grand Encampment was started.

The discovery of the Ferris-Haggarty copper mine on the North Fork of Battle Creek followed in the winter of 1898, and attention was then turned to copper, with the result that the region is being thoroughly exploited and is becoming a permanent copper producer.

The district is somewhat irregular in shape. The tract embraced in the known mineralized country extends along the Wyoming-Colorado line, easterly and westerly, for a distance of about eighty miles, and northerly and southerly for a distance of from fifteen miles at Encampment to forty miles at Elk Mountain, near Saratoga, comprising about 2,000 square miles of mountain and valley.

The North Platte River, which rises in Colorado, in this locality flows northwesterly and divides the district into two distinct halves, with a valley some fifteen miles wide lying between and watered by numerous tributary streams on either side. Parallel with the river are mountain ranges on either side, that on the east being known as the Medicine Bow Range, and with this range a series of approximately parallel or connected smaller ranges, such as Elk, Coad and Wood Mountains.

On the west is the Sierra Madre Range, composed of a number of similar ranges, known by various local names, and these form part of the great Continental Divide.

Geology—The Sierra Madre Mountains consist of an irregular core of granite, with smaller islands and spurs of the same material showing both in and through the associated metamorphic formations. The granite is usually of a reddish feldspathic variety, in many instances much altered, and showing little quartz or mica, but in others showing a predominance of quartz, inclining to the gray granites of Colorado, and frequently showing strong evidences of metamorphism, especially in the outcrops, and which is usually limited in extent.

The metamorphic formations consist principally of Algonkian schists, usually lying on the granites and having a varying dip and trend or direction in different parts of the district. These schists are of a number of varieties, some of which are local or limited in extent, the usual schist being a fine grained black mica schist, and a fine hornblende and tourmaline schist in bands vary-

ing from a few feet to several hundred feet in width. Associated with these varieties have been noted muscovite or white mica schists, and gneiss, cerisite schist, garnet schist on Upper Cow Creek, chlorite schist and amphibolite schist in various localities.

The dyke rocks noted are mainly diorites, some diabase and allied dark colored dyke rocks. These dykes vary in size from a thin band a few inches thick to a huge sheet of several hundred feet in thickness, and generally lie conformably with the adjacent schist, having the same trend or direction and the same dip, but instances are noted, as on Upper Cow Creek and near the Syndicate on Savery Creek, where the dykes cut across the formation at a varying angle. These dykes are also noted at many places in the granite near the New Rambler on Douglas Creek and near Encampment and Battle.

Associated with the schists and diorites are ledges or bands of quartzite, which lie conformably with the including schists, as far as now known, as at the Ferris-Haggarty mine and at Bridger Peak, and are usually of considerable extent.

In many instances the foregoing rocks (schists, dyke rocks and quartzites) often show an extensive and sometimes a complete metamorphism and change from their original condition and composition, leaving only the structure as a means of identification, the composing minerals being replaced by silica and lime, as the schists near the Ferris-Haggarty are largely replaced by silica and by lime on Jack Creek and at the Mohawk, on the North Fork of the Grand Encampment River.

The Snowy Range, in the Medicine Bow Mountains, is distinct in formation from the adjacent country, and consists of trachite and quartzites, with an occasional dyke of porphyry.

On either side of the Medicine Bow Range the carboniferous limestones are noted, with the succeeding sedimentary formation dipping away from the main range until covered by the wash of the valley.

Ore Deposits and Ores—In a district as little developed as the Grand Encampment country it is evident that the precise ore conditions may not be fully understood until greater depths have been reached and some of each class of ores and ore deposits fully exploited. At present these are understood to consist of two classes, viz., ores found in the hard, unchanged formation, the diorites and unaltered schists, associated with a vein quartz, as at the Blakeslee and Verde properties, south of Battle, as distinguished from the ores found as a contact deposit between two different formations, as the Ferris-Haggarty, Doane-Rambler mines, and a fissure deposit, as the New Rambler, on Douglas Creek, in a gray granite. The former may be termed original ores, and the latter secondary ores, or ores of replacement.

In the first case sulphide of copper is found in the outcrops, and with but little change beyond the surface oxidizing of the specimen and staining the adjacent rock with iron oxides and copper carbonates, often leaving the unchanged sulphides only covered by a thin film of oxides.

In the latter case the sulphides are encountered at "water level," viz., the level of permanent underground water, varying in depth in different localities and covered by a capping of iron oxides known as the iron cap and the "gossan" of the Cornish miner.

The principal ores are the yellow pyrites of copper or chalcopyrite and "peacock copper" or Bornite, as at the Ferris-Haggarty, and the Covellite ores of the New Rambler. Some phenomenally rich copper glance or chalcolite has been struck, mostly near the surface.

Gold and silver values throughout the district have uniformly been low, although some phenomenally rich gold values have been noted in the oxidized ores at Purgatory Gulch, the Charter Oak and some others, but with more attention being paid to this by-product, a higher grade may be anticipated in the future.

Grand Encampment—This town is the terminus of the Saratoga and Encampment R. R. and the practical center of the mining activity of this region. It is pleasantly located, substantially built and has about 1,000 population at the present time. Here are located the principal supply houses, bank and headquarters of the principal companies operating in this district, and is the eastern terminus of the aerial gravity tramway from the Ferris-Haggarty mine to the Encampment reduction works, the location of the Encampment Power and Light Company's works and the other enterprises owned by the Penn-Wyoming Copper Company.

Aerial Tramway—The tramway is sixteen miles in length, divided into four sections, with three auxiliary power stations, one at the mine, one at Upper Cow Creek at the foot of Bridger Peak and one at Lower Cow Creek. These stations are equipped with power plants, storage bins, etc., to facilitate the operations of the line. Three hundred and four towers, with tension stations at intervals, are used to support the cables, which, moving at an average speed of four miles an hour, with buckets holding 700 pounds of ore each, are capable of delivering 984 tons of ore per day.

Encampment Reduction Works—In March, 1906, the old concentrator was destroyed by fire and the present mill erected in its place on a larger scale and greatly improved in every way. The mill is built in two sections, so that only half the works need be idle for repairs at one time and the whole scheme of working is

automatic as far as possible, gravity being utilized to aid the separation wherever a fall can be obtained.

The ore from the receiving bins passes through a huge Blake crusher to an elevator, thence to revolving screens, the oversize passing to roughing rolls and to a conveyor which carries the entire mass to the storage bins. From these bins the ore goes to two immense Hancock jigs, capacity 700 tons each per day, for coarse and fine material, the coarse, oversized ore passing through two pairs of grinding rolls, thence to twelve No. 5 Wilfley tables for further concentration. A portion goes to regrinding rolls and the fine material, or slimes, goes on through the slime department for final treatment.

In March of this year the smelting department was seriously crippled by fire soon after the season's run had commenced, but is now being rapidly rebuilt and will soon be again in operation.

The completion of the Saratoga and Encampment Railroad from Walcott to Encampment will do away with the long wagon haul of coke and copper and put these works in a position to produce copper at a low figure.

Battle—Towards Battle the Copper Rock Company is sinking on veins of red iron oxides in schists and quartzite. This same condition is noted on the Hidden Treasure and Gertrude properties, and at intervals shows copper stains both in the capping and quartz.

On the Portland mine, owned by the Battle Lake Copper Mining Company, work has been active. Open cuts and shafts have been opened along the vein, following it west and down the hill to Battle Creek, where a tunnel was started to follow the vein east into the mountain. At thirty-five feet from the portal the vein was encountered, which at this point shows gold and copper ore of workable grade and quantity. The tunnel has since been run a distance of over 400 feet. Open cuts and shafts have been sunk along the vein for a distance of about 2,000 feet and show ore of good grade. Recent rich finds are reported in tunnel cross cuts.

The Cow Creek country along the tramway line is again active. South of Battle, the Itmay, Verde and Three Forks work is making steady progress on promising showings.

Doane-Rambler Mine—This mine has been acquired by the Penn-Wyoming Copper Company, and will be re-opened at once to produce ores for the new smelter at Encampment. A branch tramway is to be built from the nearest station and the work completed as soon as possible. This is the oldest operating mine in the district and has a production record for high grade ores, but until now no attempt has been made at regular shipments.

There is a complete mechanical plant at the Doane, the mine

being operated through a main tunnel connected with a six hundred foot shaft, drifts being run at intervals and the ore body pretty well exposed, especially on the 400, 500 and 600-foot levels, which have shown large bodies of ore of a concentrating grade.

Ferris-Haggarty Mine—This is the main producing property of the district, has produced over \$1,400,000 since it was opened up, and is the main source of ore supply for the Encampment smelter.

The vein is a contact deposit between schist and quartzite, showing a series of ore bodies varying in length up to 250 feet and in width from fifteen feet to forty feet. The ore is bornite and chalcopyrite, and the grade varies from a 35 to 40 per cent. shipping ore to a 6 and 8 per cent. concentrating ore, the latter predominating.

Originally the property was worked by shaft and hoist, but a working tunnel has been run in at the lowest practicable level (giving about 500 feet depth on the dip of the vein) and a complete plant installed at the mouth of the tunnel. The ore is stoped out by machine drills, thrown into chutes, run to the tunnel level and hauled out by compressed air haulage, seven cars to a train, and run directly into the tramway ore bins and thence to the smelter sixteen miles away.

A hoist has been installed at the tunnel level and a winze sunk below this level, where drifts are being run on the ore and an active campaign opened for the production of ore during the coming season, which opens about May and closes December 15 following.

Dillon Vicinity—Work around Dillon has been very active this year, the Anchoria, Jackpot, Independence, Pluto and Oshkosh-Wyoming Companies being especially prominent. The Congo property has developed steadily and makes a fine showing. The Bachelder has improved the plant and shaft. Work has also been active on the Octavia, Home Run and a dozen others. The Echo property is especially interesting and promising, as a shaft is being sunk on a capping of iron oxides, identical with that of the Ferris-Haggarty, but lying with schist foot-wall and quartzite hanging wall, where the Haggarty has a quartzite foot-wall and schist hanging-wall.

The Syndicate property on Savery Creek is working on a contact between an altered schist and diorite dykes. Considerable copper ore of good grade has been taken out.

In Purgatory Gulch, situated six miles south of Encampment, in 1897 some remarkably rich gold specimens were found, and formed the basis of the excitement which has developed into the Grand Encampment Copper District.

The Cox mine, on Big Creek, has produced some remarkable high grade copper ore, and several shipments have been made from it.

The Charter Oak is one of the oldest properties in the district, and is located seven miles north of Encampment, in the northern edge of the foothills. Ores consist of sulphides in lower and oxidized in upper levels.

This mine has been re-opened and new shafts sunk, the ore shown up on the lower levels and a great deal of ore exposed. A tunnel is being driven from a point on Calf Creek, on the vein and ores for a length of 2,280 feet, and will cut the ores shown in the shafts at a depth of 250 feet, making an immense body of ore blocked out as soon as the tunnel is completed, at which time a reduction works will be built.

Elk Mountain.

This is the most northerly of the ranges comprising the Medicine Bow Range in Wyoming, and is a later uplift than the Sierra Madre, on the west side of the Platte. Here the sedimentary limestones of the Carboniferous period lie on the schists and granites of the earlier formations, and at the Elk Mountain M. & M. Company's property, on the north side of Pass Creek, the ore is found near the contact of these formations. This ore, in the upper workings, is copper glance, occurring in the bunches common to this ore, and in the lower workings is giving place to the chalcocopyrite, which is becoming more common as depth is reached.

New Rambler Mine.

The Great Rambler Mine is owned by the Rambler Mining and Smelting Company, is located on the crest of the Medicine Bow Range, in Albany County, and was first opened up as a gold prospect. In 1900 the first copper was struck at a depth of sixty-five feet, and the mine began immediately to ship high grade copper ore. The formation containing the copper is a dioritic granite, with some micaceous schist in the vicinity, but the ore is found in a series of fissures in the granite. In common with the other prominent properties in Southern Wyoming, the surface and outcrops of the property show the usual oxidized forms of iron, with an occasional copper stain. The "iron hat," as this capping is called, extends to a varying depth and gives place to the various forms of copper minerals met with in this mine. The Rambler is a veritable museum of copper minerals, and nearly all the known forms have been found here either in quantity or as specimens. Native copper is noted in sheets often of a dendritic form and as small nuggets. Copper carbonates, green and blue, are abundant, as well as the silicates of copper. The red oxide of copper, Cu-

prite, and the black oxides, Tenorite and Malacconite, are noted in quantity. Covellite, or "indigo copper," is the ore that made this mine famous, as this variety has always been a rare form, and seldom, if ever, found in the quantity in which it occurs in this mine; the only small specimens of this variety are usually found in the different museums of minerals. Platinum has been found in the Rambler ores, occurring in the Covellite and showing 1.4 oz. of platinum per ton of ore. Palladium has also been noted in these ores in the Covellite ores with the platinum. The grade of ore at this property has been high and a number of cars of very high grade ore have been shipped, especially that containing the glance and Covellite. These shipments show 1,928 dry tons of ore shipped, averaging 19 per cent. copper and representing a gross value of \$77,622. The general grade of the oxidized ores is low, and to treat these ores a matte smelter of forty tons per day capacity has been installed. The matte made and shipped is given as follows: Six hundred and thirteen thousand pounds matte, 249,196 pounds copper, \$36,135.41 values. The grade of matte shipped varied from 30 to 60 per cent. copper and the total amount of copper produced to date is 828,970 pounds.

On Iron Creek a huge ledge of iron oxides is noted outcropping in general as a hard, silicious hematite, but often associated with deposits of brown limonite and frequently carrying a small copper value. The shaft sunk by the Ak-Sar-Ben Company on this material is the deepest working and shows a soft condition beneath the capping, followed by sulphides.

The **Strong Mine**, northeast of Laramie, has developed steadily. A shaft house and hoist have been erected and the development work in the main shafts and drifts on the ore has shown up a remarkable body of concentrating ore,

The Strong shaft has reached a depth of 350 feet and is the deepest working in the Laramie Hills. It has conclusively demonstrated that the ores of this section are not surface ores and the bodies opened show that the ore increases in gold values with depth, also, that blind shoots are to be expected in these deposits and are of equal grade. A plant is to be erected at the Strong and made a producer.

The camp of Silver Crown lies south of the Strong and here are a number of good properties ready to produce copper and gold as soon as a proper reduction works is erected. The Louise mine shows eleven feet of copper ore at 160 feet and four feet of this is of smelting grade.

Sunlight Mining District.

Sunlight Basin, in Big Horn County, is attracting the attention of miners and prospectors, and considerable work is being

done around Stinking Water Peak, one of the prominent peaks of the Absaroka Range. This region is located about sixty-five miles west and north of Cody, on the Burlington and Missouri River railroad, in the Yellowstone Park Timber Reserve, and about ten or fifteen miles east of the east line of the National Park.

The formations here are mostly andesites, rhyolites and porphyry. Diorite is also noted in some localities; basalt and conglomerates, both in massive sheets and dykes, are found.

Almost all the prospecting up to the present time has been in the vicinity of Stinking Water Peak, in an area of about six or seven miles square, covering the heads of Sulphur, Copper and Galena Creeks and the North Fork of the Shoshone River.

The works of the Sunlight Mining Company, in Silver Tip Basin, are the principal works of the region, and consist of three tunnels, 100 feet, 250 feet and 900 feet long, respectively, the latter being the main working tunnel, being run to cut an ore body that shows a surface width of about thirty feet of good grade ore. The ore from these works is a quartzose vein matter, carrying copper and iron sulphides, mostly chalcopyrite or yellow pyrites of copper, with a fair value in gold and silver. Some galena or lead sulphide is also found, which is often rich in silver. Shipments have been made from this property and showed a profitable return even in the face of a wagon haul of one hundred miles to the nearest railroad point at Red Lodge, Montana, after being packed for four miles down to the road from the mines.

On Sulphur Creek work has been steadily pushed by the Winona Company, and a tunnel and other works begun to reach at a considerable depth, ores indicated by promising outcrops along the ridges. This and other development works are forging steadily ahead and results are watched with interest by the whole district.

This region is favorably adapted for tunnel methods of mining, and thus prospecting may be carried on at all times and seasons, the winters being no more severe than in many of the mining regions of Colorado.

The new camp of Kirwin, lying seventy-five miles southwest of Cody, has made wonderful strides and is advancing at the present time. The Galena Ridge M. & M. Company, Shoshone Mountain Mining Company and others have been developing a large number of claims here for the past eight years, doing prospecting and improvement work where necessary, and have reached the point of permanent development. Mechanical plants are installed, mills erected and underground development work carried forward under favorable auspices.

The ores are copper and lead, carrying a higher silver and gold contents than is usual in this state, and the deeper works have

shown that the values may confidently be expected to continue and improve with depth.

Further south, toward Washakie Needle and the Wind River Range, are a number of promising prospects and a vast territory to hear from. This, with the mountains of these chains in Uinta and Fremont Counties, is the most available new and undeveloped mining country in the west, and is certain to be the scene of many rich discoveries within the next few years.

The finding of high grade copper ores at Copper Mountain, Willow Creek, and other points in these ranges within the past year is but an indication of what may be expected as soon as experienced prospectors have an opportunity to thoroughly scour the country.

North of Laramie Peak, in Albany, Laramie and Converse Counties, work on a series of heavy iron caps is actively progressing. The formation here is schist and granite, and the principal showings are a series of huge oxidized iron caps lying in ledges of schists and gneiss and which show copper minerals in nearly every instance. These caps are usually immediately underlaid by pyrrhotite and white iron pyrites as depth is gained, and these minerals seem to be replaced by quartz and chalcopyrite or yellow pyrites of copper.

Prominent properties on these showings are the Maverick, Tenderfoot, Three Cripples and Maggie Murphy.

The Maggie Murphy Company is installing a machinery plant for deep work, and the present showings in the main shaft are very encouraging.

The Esterbrook, which is the oldest location in this district, is sinking a shaft on the vein of silicious lead carbonate and has reached a depth of 335 feet. The showings here indicate that this lead cap is underlaid by copper sulphides associated with galena or lead sulphides, and the company is now beginning to cross-cut and develop its showings at this depth. A reduction plant is being considered.

West of the above properties are the Oriole and LaBonte in LaBonte Cañon. At LaBonte a tunnel has been run for a length of 550 feet, at which point the formation was cross-cut, showing a schist dyke highly mineralized with a width of 150 feet. A drift near the center of this dyke has shown a shoot of low grade of copper ores, and other shoots are expected as this development proceeds.

At the Oriole mine development work has shown a low grade copper concentrating proposition, and a mill is expected to be installed during the coming summer.

The list of promising prospects might be indefinitely continued in every mountain range in the state did space permit, but only

the most prominent and best known localities are mentioned, and to name all would require a separate publication.

A series of bulletins on the different minerals and mineral districts is being prepared and will treat fully the various camps and the showings made, as the present writing is but an outline of the whole state.

The total copper production of Wyoming from the earliest record to December 31, 1906, is as follows, the prices given being the average price of copper for the year:

YEAR	NUMBER OF POUNDS	PRICE PER POUND	VALUE
1882	7,500	17.100 cents	\$ 12,757.50
1883	962,468	13.700 cents	131,858.11
1888	232,819	15.900 cents	36,017.32
1889	100,000	12.000 cents	12,000.00
1895	6,872	10.110 cents	694.07
1897	127,471	11.100 cents	14,149.28
1898	233,044	12.000 cents	27,965.28
1899	3,104,827	17.100 cents	530,925.39
1900	4,206,776	16.250 cents	683,601.50
1901	914,412	16.110 cents	140,909.82
1902	75,297	11.620 cents	8,749.51
1903	947,106	13.420 cents	127,101.62
1904	4,220,000	12.831 cents	541,046.20
1905	2,420,629	15.590 cents	355,376.06
1906	50,000	19.278 cents	9,639.00
Total	17,676,721		\$2,632,790.66

The burning of the Penn-Wyoming Copper Company's concentrator at Encampment in March of 1906, was the cause of the copper production of that year being so low, the other shipments made being only test shipments from various properties throughout the state.

Oil, the Light of Ages

When it comes to oil, Wyoming certainly bids fair to illuminate and lubricate the works of man for generations. The eighteen oil fields known in this state present a greater variety of product than any similar known area, as it varies from the highest grade of lubricating oils without a trace of illuminating constituents to an equally high grade of illuminating oil totally free from lubri-

cants, and with a range of intermediate oils and products that is a revelation to oil men,

In each of the eighteen oil fields oil is flowing from springs, or there are thick bands of oil sand exposed. The greater number of these fields are situated in the central part of the state, but there are fields in the northeastern portion, in the southwestern part, and in the northern central region. The oils that have been analyzed vary in nature from high grade lubricating to oils that will produce from 40 to 50 per cent. of kerosene.

With proper facilities for transportation, the oil industry in Wyoming will equal, if not surpass, that of any other state.

The greatest development is found in Natrona County, where a lubricating oil is found which has been pronounced by experts to be the best in the world; and in Fremont County, where there are thirteen flowing wells, now capped for the want of a railroad. At Casper there is a refinery having a capacity of 200 barrels of crude oil per day. The product is hauled from the wells in wagons that have a carrying capacity of 18,000 pounds, each train of wagons requiring twelve to sixteen mules. This greatly adds to the expense of production. At present the following oils are manufactured at Casper: Railroad engine, railroad car, railroad valve and railroad signal. These oils are the most perfect lubricants, of high endurance, highest fire test, and greatest body and wearing power. Besides railroad oils, the refinery manufactures other special high grade oils, viz.: Stationary engine, valve, spindle oils, dynamo oils, watch oils, neutral oils for blending animal and vegetable oils, paint oil, visco axle grease, and heavy machine oil for mowing machines. The product of eight producing wells varies in value from twenty cents to one dollar and fifty cents per gallon.

The Bonanza field in Big Horn County, is attracting a great deal of attention; five wells recently drilled struck oil at 280 feet.

The Popo Agie Oil Field—This field is situated ten miles southeast of Lander, Fremont County. It covers several townships and extends north to Lander. The history of this field is far more interesting than any other oil field. It was discovered by Bonneville in 1833, and is the place where the first producing oil well was drilled. From the date of Bonneville's visit up to 1867 the oil spring was unknown, except to the hunter or trapper, who frequented the locality to secure the oil for medicinal, lubricating, illuminating and other purposes. There are now thirteen flowing wells, with a capacity each of 200 barrels per twenty-four hours; owned by the Belgo-American Drilling Trust, as are also the lubricating oil wells situated on Salt Creek, with the refinery at Casper. The oil appears black, is reddish brown by transmitted light and has a strong, disagreeable odor.

In refining the products are gasoline and kerosene, about 35-

45 per cent., and the balance lubricating oils and asphaltum. The oil is of heavy asphaltum base and suitable for high grade fuel, tests giving 14,571,000 foot pounds of energy per pound of oil. One pound of this oil will convert 19.40 pounds of water at 212° F. into steam.

Lander and Shoshone Oil Fields—The Lander field joins the Popo Agie on the north, and the Shoshone joins the Lander on the north, extending into the Wind River Indian Reservation. Drilling is now going on near Lander for wells to supply the Wyoming and Northwestern R. R. with fuel oil from these fields, tests on the engines having proven very satisfactory.

Salt Creek Oil Field—This is the producing field of Wyoming mentioned in the beginning of this article and lies fifty miles north of Casper in Natrona County. There are fourteen producing wells, eight of which have been pumped for ten years and show as much oil as ever; the average depth of about 800 feet and there is considerable gas pressure.

The oil is the finest natural lubricant known and contains not a trace of illuminating oils.

It has properties as follows:

Specific gravity9105 at 60 degrees F.
Flashing point	255 degrees F.
Burning point	320 degrees F.
Congealing point	17 degrees F.

Its remarkably low congealing point and high fire test, combined with its great viscosity and freedom from tarry and gumming products render it especially valuable in railroading, and it is used on a number of western roads to-day.

Uinta County Oil Fields—This district includes several fields—Bear River Basin, Round Mountain, Fossil, Spring Valley, Twin Creek, Carter and Hilliard—and has many natural advantages over the other districts on account of its proximity to transportation, the Union Pacific railroad, and the points of distribution, Salt Lake and Ogden.

The following analysis is a fair representation of the oil from several fields in this district:

	Per cent.
Naptha, 60° F. (gasoline and benzine)	27.0
Water white kerosene, 45° Baumé, 145° flash, 172° fire test . . .	25.5
Signal and headlight, 45° Baumé, 300° fire test	7.0
Lubricating reduced stock, 23.5° Baumé	40.5

100

The cold test of the crude oil is 58° F., and the amount of crystallized paraffin that was present in the lubricating stock is 18.5 per cent.

The **Newcastle Oil Field** is located in the vicinity of Newcastle, county seat of Weston County, on the Burlington railroad.

This petroleum is similar in composition to the Salt Creek oils and belongs to the class of heavy oils, and is not suitable for the production of gasoline or kerosene, although they can be obtained from it. Its chief value will be for lubricating and for fuel purposes. It is, in its natural state, an excellent lubricant, has a high gravity and low cold test, a high viscosity and shows no paraffin or asphalt. This oil is also well fitted for the manufacture of gas.

The Newcastle petroleum as represented by the samples taken from the pit of Eagle Spring has a specific gravity of .9168 (22.8° Baumé). It flashes at 122° C. (251.6° F.) and takes fire at 153 C. (307.4° F.). The odor is not disagreeable, and for many purposes it could be sold as a lubricating oil in a crude state. No paraffin crystallizes out on cooling and little or no asphalt is left on distilling. The viscosity at 60° F. is 29.43, using Engler's viscosimeter and compared with the viscosity of water.

The **Bonanza Oil Field** and the **Cottonwood Oil Field** are in close proximity to each other in Big Horn County, near the No Wood River, a tributary of the Big Horn. Active development work is now being carried on in this district, a very fine grade of oil having been found.

Analysis of Bonanza Oil—Specific gravity, .8446 (36° Baumé). Color: Red; strong green fluorescence. Odor: Like Kerosene. Flashing point: 13° C. (55° F.). Burning point: 35° C. (95° F.).

This petroleum will work up into the following products:

Gasoline	20 to 25 per cent.
Kerosene	55 to 60 per cent.
Light lubricating oil	5 to 10 per cent.
Paraffin	2 to 4 per cent.
Coke and loss	4 to 6 per cent.

The **Douglas Oil Field** is situated a short distance south of Douglas, county seat of Converse County, elevation 5,000 feet. The quality of the crude oil in this section is exceptional and will work up into remarkable lubricating oils.

The **Oil Mountain Field** is situated twenty-five miles west of Casper, Natrona County. This petroleum is principally valuable for lubricating purposes, although the most of it could be worked up into kerosene for open lamps, such as miners use.

The **Dutton Oil Field** is situated partly in Fremont County

and partly in Natrona County. Many oil springs are found here and natural gas is quite abundant. There is practically no development in this district. The oil has a gravity of .927 (21° B.).

The Belle Fourche Oil Field is situated about fifteen miles north of Moorcroft, on the Burlington railroad, in Crook County. In the early history of the discovery of gold in the Black Hills, needing lubricating oil for the machinery, men were employed in this field in collecting oil from the springs, which was transported by wagon to Deadwood and there sold for \$28 per barrel.

The Powder River Oil Field is located on the South Fork of Powder River, sixty miles northwest of Casper, county seat of Natrona County; fifty miles south of Buffalo, county seat of Johnson County. There are many oil springs in this field. This is one of the best fields in Wyoming; the structural features are ideal. This petroleum is heavy and black; the odor is slight, resembling common kerosene, and in general character is similar to Salt Creek oil and the Popo Agie oil.

The Rattlesnake and Arago Oil Fields are on the northeast slope of the Rattlesnake Mountains in Natrona County. Here is found asphaltum in sufficient quantities for commercial importance, if it were not for the lack of transportation.

Development—The successful and profitable development of many of the oil fields depends largely upon the construction of new railway lines—an investment fully warranted by this resource—but there are a great many opportunities presented in many of the fields which are adjacent to present railway lines for profitable and highly remunerative development.

In noting the different oil fields of the state, only a condensed statement of each has been here given, as it is the intention to issue a separate bulletin on the oil fields of Wyoming in the near future and give therein all available information.

